5.3 GEOLOGY AND SOILS

5.3.1 Introduction and Methodology

At the time FSEIR #01-01 was prepared, the Vistas Parcel, including the proposed project site, was primarily undisturbed and consisted of the Diablo clay soil series. FSEIR #01-01 concluded that significant impacts to soils could occur due the expansive and compressible nature of this soil, unless specific design measures were incorporated.

FSEIR #01-01 stated that there are no active faults underlying the project site and that the most probable seismic event with potential to affect EastLake III would be associated with the Rose Canyon Fault. Therefore, the analysis concluded that the Uniform Building Code, California Building Standards Code (California Code of Regulations, Title 24), and incorporation of standard practices of the Association of Structural Engineers of California into the design of the project would ensure that impacts related to geologic hazards would be less than significant.

This section provides a summary of the existing geology and soil conditions, potential impacts associated with construction and operation of the proposed project, and mitigation measures to reduce potentially significant impacts.

Existing geological conditions were obtained from FSEIR #01-01 and referenced with other available geology documents, including the technical report prepared for the proposed project. A geotechnical study was conducted for the project and documented in the *Geotechnical Investigation for EastLake Active Senior Resort* (Geotechnics Incorporated., June 10, 2005). This report characterizes pertinent geotechnical conditions at the site and provides recommendations for geotechnical aspects of earthwork anticipated during construction. A complete copy of the report has been included as *Appendix B* to this document. The study included a literature review of available maps, geotechnical reports, and aerial photography, as well as a site reconnaissance of surface features. The study also included a subsurface exploration using a truck-mounted drill rig. The subsurface investigation consisted of 14 hollow stem auger borings obtained from representative locations within the proposed site. Core samples obtained from the borings were visually analyzed in the field and sent to a laboratory for further analysis. Laboratory results can be reviewed in *Appendix C* of the *Geotechnical Investigation for the EastLake Active Senior Resort* (see *Appendix B* to this EIR).

5.3.2 Existing Conditions

Surface and Subsurface Conditions

The proposed site is located within the coastal plain section of the Peninsular Ranges geomorphic province of California. The coastal plain typically consists of subdued landforms underlain by sedimentary formations. The project site is underlain predominantly by the Oligocen-age Otay Formation, which has been covered with compacted fill. The Otay formation varies from silty or clayey sandstone to sandy siltstone or claystone. The canyon in the south-central portion of the site was filled in the 1990's as part of the East Orange Avenue development (Geotechnics, Incorporated, 2004). Further grading occurred onsite in accordance with the approved grading plan for the Vistas at EastLake III development. As-grade reports prepared by Geotechnics Incorporated indicate that existing compressible soils were excavated and compacted prior to placing new fills. Therefore, the existing site conditions include compacted fill soils.

Groundwater

Groundwater is water found below the land surface in aquifers, pore spaces, unconsolidated sediments, and as soil moisture. Groundwater flows to the surface naturally at springs and seeps and can pool in depressions on the land surface. It may also be tapped artificially by the digging of wells for beneficial uses such as drinking water and irrigation. Groundwater observations were not recorded during subsurface exploration between 11.5 and 19.5 feet below the surface. No seepage or groundwater was observed at these depths during the geotechnical investigation. However, changes in rainfall, irrigation practices, or site drainage patterns could produce seepage or locally perched groundwater within the site.

Seismicity and Ground Motion

Earthquake activity, also known as seismicity, is common throughout the southern California region. San Diego County has a number of active earthquake faults which generally run in a northwest-southeast direction and are the product of crustal stresses associated with movement of the Pacific and North American lithospheric plates. Since the inception of seismographs, the strongest recorded earthquake in coastal San Diego County was the magnitude 5.3 temblor that occurred in 1986 on the Coronado Bank Fault, located 25 miles off the shore of Solana Beach. In recent years there have been several earthquakes recorded within the Rose Canyon Fault Zone as it passes beneath the city of San Diego, including a magnitude 4.0 in 1985, a magnitude 4.7 in 1986 and a small earthquake on October 16, 2005.

Alquist-Priolo Fault Zones have been established to prevent buildings for human occupancy from being constructed upon active faults. Statutes require that the State Geologist define regulatory zones (known as Earthquake Fault Zones or Special Studies Zones) around the surface traces of active faults and to issue appropriate maps to cities and counties for planning and controlling new or renewed construction (www.consrv.ca.gov, accessed May 2005). As shown on *Figure 5.3-1*, *Geological Hazards Map*, the project site is not located within an Alquist-Priolo Fault Zone. Additionally, site investigations showed no indications of active faulting onsite.

The Rose Canyon fault is the nearest active fault to the project area and is characterized as a right lateral strike-slip fault. Portions of the Rose Canyon Fault Zone in downtown areas of San Diego have been designated by the State of California as an Alquist-Priolo Fault Zone. *Table 5.3-1*, *Active Faults in the Vicinity of the Project Area* below provides additional details on the Rose Canyon and other nearby faults. *Figure 5.3-1*, *Geologic Hazards Map*, shows active faults within 60 miles of the project site. It should be noted that the La Nacion fault is located within the City of Chula Vista. However, this fault has not demonstrated movement within the Holocene period (last 11,000 years) and is therefore not considered an active fault (Belfast, September 26, 2005, personal communication).

TABLE 5.3-1
Active Faults in the Vicinity of the Project Area

Fault	Distance to Site (miles)	Estimated Peak Ground Acceleration	Maximum Earthquake Magnitude	Estimated Slip Rate (mm/year)
Rose Canyon	13	0.22	7.2	1.50
Coronado Bank	21	0.17	7.6	3.00
San Diego Trough	31	0.13	7.7	2.00
Elsinore-Julian	37	0.07	7.1	5.00
Elsinore-Coyote Mt.	39	0.05	6.8	4.00
Earthquake Valley	40	0.04	6.5	2.00
Newport-Inglewood	45	0.06	7.1	1.50
San Clemente	50	0.10	8.1	4.00
Elsinore-Temecula	50	0.04	6.8	5.00
San Jacinto-Coyote Creek	56	0.03	6.8	4.00
San Jacinto- Borrego	56	0.03	6.6	4.00
Laguna Salada	56	0.04	7.0	3.50
San Jacinto-Anza	60	0.04	7.2	12.00

Source: Geotechnics Incorporated, 2004. Regional Seismicity Table 1.

Figure 5.3-1 Geological Hazards Map

Liquefaction

Liquefaction typically occurs when seismic shear waves pass through a saturated granular soil layer, such as sandy soil layers located below groundwater, distort the soil structure, and cause some of its pore spaces to collapse. Earthquake shaking can cause liquefaction by increasing subsurface water pressure to the point where soil particles can readily move with respect to each other, resulting in subsidence, ground failure, or landslides. Considered much less common, construction related activities, such as blasting, can also trigger liquefaction. When liquefaction occurs, the strength of the soil decreases and the ability to support foundations for buildings and other structures is compromised. The soils onsite are generally unsaturated, relatively dense, compacted silty to clayey sands and sandy clays. These soil conditions typically have a very low potential for liquefaction.

Landslides

Landslides occur or originate on steep hillsides where weak earth materials are prone to slope failure. Site investigations did not reveal evidence of ancient landslides within the subsurface material nor did literature reviews indicate that the site is within a potential landslide area. However, recent mass grading of the site resulted in relatively high slopes. Geotechnics Incorporated has document stabilization measures that were used during previous grading to prevent slope failure. Similar measures are discussed in *Section 5.3.4* below.

Tsunamis, Seiches, and Earthquake Induced Flooding

Tsunamis usually generate from an undersea earthquake that displaces a large mass of water and forces it landward in the form of a wave. Tsunamis have been known to travel thousands of miles across the ocean and cause damage to coastal cities. A seiche consists of water oscillation in lakes, bays, or gulfs that can last from a few minutes to a few hours as a result of seismic or atmospheric disturbances. The project site is located more than 550 feet above mean sea level. Consequently, tsunamis, seiches, and earthquake induced flooding are not expected to occur on the project site given its distance inland and elevation above the Otay Reservoirs. Similarly, the potential for earthquake induced flooding is also considered negligible since the site is not located “down elevation” from any large body of water.

Expansive Soils

Expansive soils can cause adverse effects on residential structures when certain clays swell or shrink during changes in moisture content. The soils observed onsite during site investigations consisted primarily of silty and clayey sands which typically have very low to low expansion potential and have previously been compacted therefore expansive soils have been remediated. Several soil samples were obtained at varying depths for laboratory analysis to further classify the expansion potential based on the American Society for Testing of Materials (ASTM) expansion index. Expansion indices ranged from 7 to 47 which correspond to very low to low expansion potential. During previous phases of grading, a canyon in the south-central portion of the project site was filled. Alluvium found in the canyon would likely have higher clay content and therefore a higher probability of encountering expansive soils.

5.3.3 Thresholds of Significance

According to the significance criteria included in Appendix G of the CEQA guidelines, impacts to geology and soils would be significant if the proposed action would result in any of the following:

Would the project:

1) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:
   a) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.
   b) Strong seismic ground shaking?
   c) Seismic-related ground failure, including liquefaction?
   d) Landslides?

2) Result in substantial soil erosion or the loss of topsoil?

3) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

4) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

5) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

5.3.4 Environmental Impacts

Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving.

Would the project expose people or structures to rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

As shown in *Figure 5.3-1*, *Geologic Hazards Map,* the proposed project site is not located within an Alquist-Priolo fault zone or on a known active fault. Therefore, because the project is not located within an Alquist-Priolo Earthquake Fault Zone, impacts resulting from ground rupture would be less than significant.

Would the project expose people or structures to strong seismic ground shaking?

Ground shaking could occur as a result of a seismic activity on a nearby active fault (refer to *Table 5.3-1*, *Active Faults in the Vicinity of the Project Area*). Risk associated with seismic ground shaking could potentially be significant. However, conformance to standard practices of the Association of Structural Engineers of California and compliance the Title 24 of the California code of Regulations and the Uniform Building Code, would reduce impacts from ground motion to a less than significant level.

Would the project expose people or structures to seismic-related ground failure, including liquefaction?

Groundwater is not anticipated to be encountered during construction of the project based on field observations of groundwater levels and the proposed design of the project. Soils conducive to liquefaction were not identified during field investigation or subsequent literature reviews. Therefore, due to the lack of anticipated seismic-related ground failure including liquefaction, impacts associated with this geotechnical hazard would not occur.

Would the project expose people or structures to landslides?

Slope instability could occur as a result of steep fill slopes generated during recompaction of the existing pad. Soil saturation from over watering landscaping, natural precipitation, and run-on from adjacent sites would also contribute to slope instability. Slope instability could lead to localized landslides. Impacts related to slope instability would be considered potentially significant.

***Optional Construction Road*:** Similar to the proposed project, the construction road is not located within an Alquist-Priolo Earthquake Fault Zone, therefore risk of ground rupture impacts would be less than significant. Similar to the proposed project, seismic-generated ground shaking could occur in the project area, therefore the same mitigation for the proposed project would be necessary. Due to the shallow nature of site preparation work for the trail, groundwater contact is not expected. Finally, similar to the proposed project, due to the sloping nature of the impact area, landslide hazards would be potentially significant. The same mitigation as the proposed project would be applicable.

***Optional Pedestrian Trail*:** Similar to the proposed project, the trail is not located in an Alquist-Priolo Earthquake Fault Zone therefore risk of ground rupture would be less than significant. Seismic-generated ground rupture risk would be potentially significant, therefore mitigation, in the form of conformance with the Uniform Building Code, would be required. Due to the shallow nature of site preparation work for the trail, groundwater contact is not expected. Finally, due to the sloping nature of the trail area, landslide hazards would be potentially significant. The same mitigation for the proposed project would be required for this project feature.

Would the project result in substantial soil erosion or the loss of topsoil?

Currently, the project site has a moderate to high erosion potential due to the lack of vegetation or other measures to minimize soil detachment and transport. Perimeter sediment control has been established to trap eroded material onsite and minimize sedimentation to adjacent areas. The potential for erosion would increase during construction as a result of vehicles and heavy equipment accelerating the erosion process. Additionally, wind erosion could occur on bare soils or where vehicles and equipment cause dust. While these impacts would be considered short-term in nature, they would be significant due to the potential to result in substantial soil erosion or loss of topsoil. During the operation phase of the project, soils would be stabilized with vegetation and landscaping which would reduce the erosion potential to less than significant. For a more detailed discussion on soil erosion, refer to *Section 5.4, Water Quality and Hydrology*.

***Optional Construction Road*:** During construction, soil erosion could occur due to the steep nature of the proposed temporary access road and vehicular traffic which may accelerate erosion processes. Similar to the proposed project, this potential impact would be significant and mitigation is provided. Upon completion of construction activities, the construction road would be re-graded to pre-construction standards and re-landscaped with native vegetation. Therefore after construction is complete, erosion hazards would be less than significant.

***Optional Pedestrian Trail*:** As described for the proposed project, soil erosion may occur during construction due to exposed, graded areas and vehicular (construction) traffic which tends to accelerate erosion processes. Mitigation is provided to reduce the significance of this impact. Once construction is complete, the trail area would be stabilized with decomposed granite. In summary, upon completion, erosion hazards would be less than significant.

Would the project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

Since the preparation of FSEIR #01-01, mass grading has occurred and the soil structure and composition has been significantly altered. In addition, soil samples were obtained from the site after grading had occurred and laboratory tested for physical properties that are critical to building design.

The project site is located on soils that have been highly disturbed and mechanically altered during previous grading activities. A considerable portion of the site is overlain by fill material that was placed for purpose of constructing building pads. Therefore, because the project would not be located on a geologic unit or soil that is unstable, or become unstable as a result of the project, impacts to soils would be considered less than significant.

***Optional Construction Road*:** The proposed construction road would be located on the same manufactured slope as the proposed project. This slope has been previously disturbed during grading of the site. As discussed above, the slope to the south of the project site was constructed to support building pads. In accordance with generally accepted construction methods, this slope was designed to support building pads. The temporary roadway would be designed to support vehicle traffic for the intended duration of construction. Engineering of the road would reduce impacts associated with potential lateral spreading, landslides, subsidence, liquefaction or collapse to a level below significant.

***Optional Pedestrian Trail*:** The proposed trail is located on the OTC site. A majority of the OTC site is underlain by the Sweetwater and Otay Formations and Unnamed fanglomerate deposits (Kennedy, USDA Soil Conservation Service and City of Chula Vista, 1989). These geologic formations may contain expansive soils due to the presence of bentonite, which can often result in movement risks (i.e., lateral spread, landslides, etc). No cut and fill slopes are necessary to construct the trail (i.e., surface disturbance would be minimal and simply involve clearing and leveling of to the top layer of soil), therefore, less than significant impacts from expansive soil risks would occur.

Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

As discussed in *Section 5.3.2*, soil samples taken at various depths indicated that soils onsite have very low to low expansion potential. During initial site preparation and compaction, alluvial material from nearby canyon formations was utilized at the interior/base of the site. Alluvial material is generally expansive, therefore during subterranean parking structure excavation, expansive soils could be exposed. Potential exposure to expansive soils would result in a potentially significant impact.

***Optional Construction Road*:** The proposed temporary construction road would be created by leveling the proposed alignment and overlaying decomposed granite on top of the existing soils. No impacts would result.

***Optional Pedestrian Trail*:** See discussion under the above threshold,

Would the project have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

Sewer will be provided to the project site; therefore soils will not have to adequately support the use of septic tanks or alternative wastewater disposal systems.

***Optional Construction Road*:** The use of alternative wastewater disposal systems or septic tanks would not be a component of this project feature. No impacts would occur.

***Optional Pedestrian Trail*:** Alternative wastewater disposal systems or septic tanks are not components of this project feature. No impact would occur.

5.3.5 Level of Significance Prior to Mitigation

Impacts associated with slope instability would potentially be significant. Erosion during construction, although short-term in nature, could be significant without erosion control measures. Structures will be located over underground parking. Potentially significant impacts to foundations and structures could occur if expansive soils are encountered. Potential impacts resulting from other geological hazards such as seismic activity would be significant.

5.3.6 Mitigation Measures

The following mitigation measures are recommended to ensure that potential impacts from unstable soils, erosion, and geologic hazards are minimized and include measures to reduce the potential for liquefaction.

5.3-a Prior to approval of grading plans, the following conditions are required to be on the plans. The proposed project's grading plans shall demonstrate compliance with remediation recommendations in the June 10, 2005 Geotechnical Investigation for the project prepared by Geotechnics Incorporated, including but not limited to:

a) Upper soil layers shall be removed to a depth of two to three feet during initial construction periods and replaced with competent compacted fill.
b) Replacement of native soils with compacted fill shall be required to eliminate the potential for liquefaction.
c) Any areas subjected to new fill or structural loads shall be prepared with compacted fill.

5.3-b Prior to approval of grading plans, a Storm Water Pollution Prevention Plan (SWPPP) shall be prepared for the project that identifies specific Best Management Practices (BMPs) to minimize erosion and control sedimentation. A copy of the SWPPP will be kept onsite and issued to all supervisory staff working on the project. Project activities resulting in excess erosion shall be halted and BMPs adjusted to ensure off-site sedimentation is avoided.

5.3.7 Significance of Impacts after Mitigation

Implementation of Mitigation Measures 5.3-a and 5.3-b would reduce significant impacts related to geologic hazards to below significance.